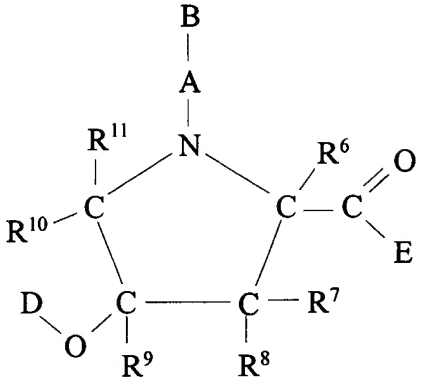
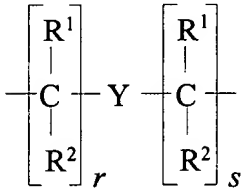
What is claimed is:

1. A compound comprising the structure:

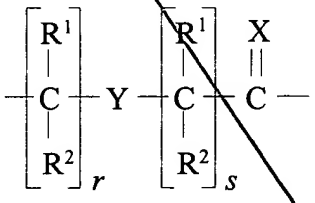


wherein B is H, a naturally occurring nucleobase, a non-naturally occurring nucleobase, an aromatic moiety, a DNA intercalator, a nucleobase-binding group, a heterocyclic moiety, or a reporter group, wherein amino groups are, optionally, protected by amino protecting groups;

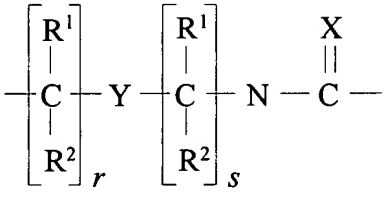
wherein A is a group of formula (Ia), (Ib), or (Ic);



I(a)



I(b)



I(c)

wherein *r* and *s* are, for I(a) and I(b), independently of one another, values from 0 to 5 and are, for I(c), independently of one another, values from 1 to 5;

wherein each R^1 and each R^2 is, independently, hydrogen, (C_1 – C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 – C_6)alkyl, hydroxy, alkoxy, alkylthio, amino, or halogen;

wherein each of R^3, R^4, and R^5, is, independently, hydrogen, (C_1 –C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, hydroxy, alkoxy, amino, aryl, aralkyl, heteroaryl, or an amino acid side chain;

Y is a single bond, O, S, or NR^4; and

X is O, S, Se, NR^5, CH_2, or $C(CH_3)_2$;

wherein R^6 is hydrogen, (C_1 –C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, aryl, aralkyl, heteroaryl, or an amino acid side chain;

wherein R^7 is hydrogen, (C_1 –C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, hydroxy, alkoxy, alkylthio, amino, aryl, aralkyl, heteroaryl, or halogen, and R^8 is hydrogen, (C_1 –C_6) alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, aryl, aralkyl, or heteroaryl;
or R^7 is hydrogen, (C_1 –C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, alkoxy, aryl, aralkyl, or heteroaryl, and R^8 is hydrogen, (C_1 –C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, hydroxy, alkoxy, alkylthio, amino, aryl, aralkyl, heteroaryl, or halogen;

wherein R^9 is hydrogen, (C_1 –C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, alkoxy, aryl, arylkyl, or heteroaryl;

wherein each of R^{10} and R^{11} is, independently, hydrogen, (C_1 –C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, aryl, aralkyl, heteroaryl, or an amino acid side chain;

wherein D is a protecting group compatible with the conditions of ester, amide, or phosphonoester bond formation, R^{18}, or $NR^{18}R^{19}$;

wherein E is O^-, OCH_3, a protecting or activating group compatible with ester, phosphoester, or phosphonoester bond formation, R^{20}, $NR^{20}R^{21}$, or OR^{20}; and

wherein each R^{18}, R^{19}, R^{20}, and R^{21} is, independently, hydrogen, (C1-C6)alkyl, an amino protecting group, a reporter group, an intercalator, a chelator, a peptide, a protein, a carbohydrate, a lipid, a steroid, a nucleotide or oligonucleotide, or a soluble or nonsoluble polymer.

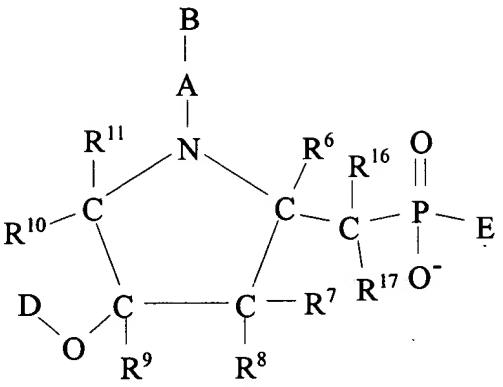
2. The compound of claim 1, wherein D is a protecting group selected from the group consisting of DMTr, MMTr, Tr, TBDMS, or tetraydropyranyl.

3. The compound of claim 2, wherein E is O^-, OH, or OCH_3.

4. The compound of claim 1, wherein B is a nucleobase.

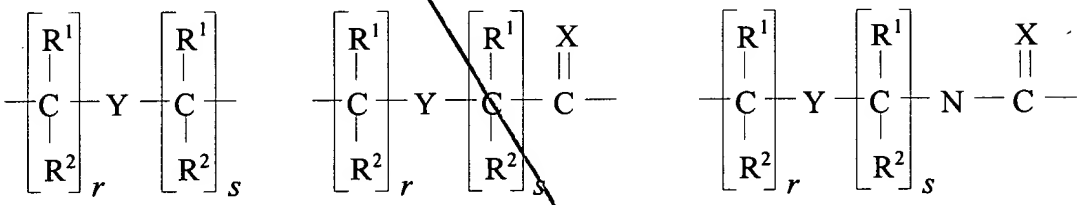
5. The compound of claim 4, wherein B is a naturally-occuring nucleobase.

6. A compound comprising the structure:



wherein B is H, a naturally occurring nucleobase, a non-naturally occurring nucleobase, an aromatic moiety, a DNA intercalator, a nucleobase-binding group, a heterocyclic moiety, or a reporter group, wherein amino groups are, optionally, protected by amino protecting groups;

wherein A is a group of formula (Ia), (Ib), or (Ic);



I(a) I(b) I(c)

wherein *r* and *s* are, for I(a) and I(b), independently of one another, values from 0 to 5 and are, for I(c), independently of one another, values from 1 to 5;

wherein each R^1 and each R^2 is, independently, hydrogen, (C_1 – C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 – C_6)alkyl, hydroxy, alkoxy, alkylthio, amino, or halogen;

wherein each of R^3, R^4, and R^5, is, independently, hydrogen, (C_1 –C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, hydroxy, alkoxy, amino, aryl, aralkyl, heteroaryl, or an amino acid side chain;

Y is a single bond, O, S, or NR^4; and

X is O, S, Se, NR^5, CH_2, or $C(CH_3)_2$;

wherein R^6 is hydrogen, (C_1 –C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, aryl, aralkyl, heteroaryl, or an amino acid side chain;

wherein R^7 is hydrogen, (C_1 –C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, hydroxy, alkoxy, alkylthio, amino, aryl, aralkyl, heteroaryl, or halogen, and R^8 is hydrogen, (C_1 –C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, aryl, aralkyl, or heteroaryl;
or R^7 is hydrogen, (C_1 –C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, alkoxy, aryl, aralkyl, or heteroaryl, and R^8 is hydrogen, (C_1 –C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, hydroxy, alkoxy, alkylthio, amino, aryl, aralkyl, heteroaryl, or halogen;

wherein R^9 is hydrogen, (C_1 –C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, alkoxy, aryl, arylkyl, or heteroaryl;

wherein each of R^{10} and R^{11} is, independently, hydrogen, (C_1 –C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, aryl, aralkyl, heteroaryl, or an amino acid side chain;

wherein each each of R^{16} and R^{17} is, independently, hydrogen, (C_1 –C_6) alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, hydroxy, alkoxy, alkythio, aryl, aralkyl, or heteroaryl;

wherein D is a protecting group compatible with the conditions of phosphonoester or phosphonamide bond formation, R^{18}, or $NR^{18}R^{19}$;

wherein E is a protecting or activating group compatible with ester, phosphoester, or phosphonoester bond formation, O^-, R^{20}, $NR^{20}R^{21}$, or OR^{20}; and

wherein each R^{18}, R^{19}, R^{20}, and R^{21} is, independently, hydrogen, (C1-C6)alkyl, an amino protecting group, a reporter group, an intercalator, a linker, a chelator, a peptide, a protein, a carbohydrate, a lipid, a steroid, a nucleotide or oligonucleotide, or a soluble or nonsoluble polymer.

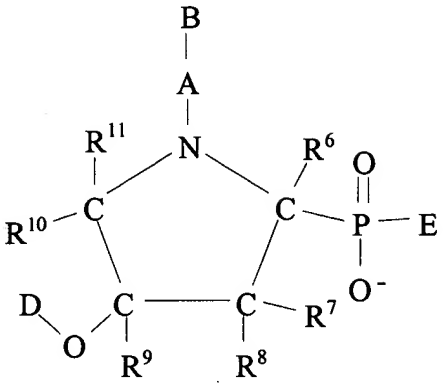
7. The compound of claim 1, wherein D is a protecting group selected from the group consisting of DMTr, MMTr, Tr, TBDMS, or tetraydropyranyl.

8. The compound of claim 2, wherein E is O^-, OH, 1-oxydo-4-methoxy-2-picolyloxy, phenoxy, 2-methylphenoxy, or 2-cyanoethoxy.

9. The compound of claim 1, wherein B is a nucleobase.

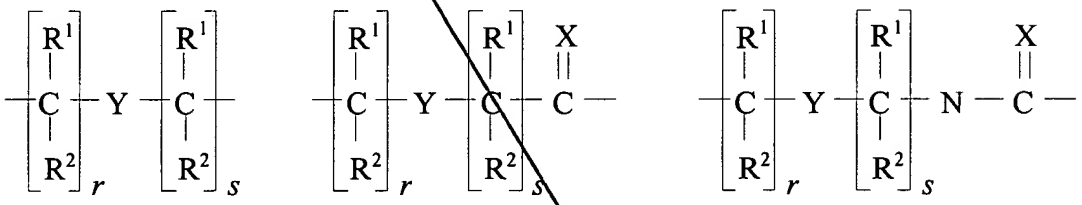
10. The compound of claim 3, wherein B is a naturally-occuring nucleobase.

N. A compound comprising the structure:



wherein B is H, a naturally occurring nucleobase, a non-naturally occurring nucleobase, an aromatic moiety, a DNA intercalator, a nucleobase-binding group, a heterocyclic moiety, or a reporter group, wherein amino groups are, optionally, protected by amino protecting groups;

wherein A is a group of formula (Ia), (Ib), or (Ic);



I(a) I(b) I(c)

wherein *r* and *s* are, for I(a) and I(b), independently of one another, values from 0 to 5 and are, for I(c), independently of one another, values from 1 to 5;

wherein each R^1 and each R^2 is, independently, hydrogen, (C_1 – C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 – C_6)alkyl, hydroxy, alkoxy, alkylthio, amino, or halogen;

wherein each of R^3, R^4, and R^5, is, independently, hydrogen, (C_1 –C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, hydroxy, alkoxy, amino, aryl, aralkyl, heteroaryl, or an amino acid side chain;

Y is a single bond, O, S, or NR^4; and

X is O, S, Se, NR^5, CH_2, or $C(CH_3)_2$;

wherein R^6 is hydrogen, (C_1 –C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, aryl, aralkyl, heteroaryl, or an amino acid side chain;

wherein R^7 is hydrogen, (C_1 –C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, hydroxy, alkoxy, alkylthio, amino, aryl, aralkyl, heteroaryl, or halogen, and R^8 is hydrogen, (C_1 –C_6) alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, aryl, aralkyl, or heteroaryl;
or R^7 is hydrogen, (C_1 –C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, alkoxy, aryl, aralkyl, or heteroaryl, and R^8 is hydrogen, (C_1 –C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, hydroxy, alkoxy, alkylthio, amino, aryl, aralkyl, heteroaryl, or halogen;

wherein R^9 is hydrogen, (C_1 –C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, alkoxy, aryl, arylkyl, or heteroaryl;

wherein each of R^{10} and R^{11} is, independently, hydrogen, (C_1 –C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, aryl, aralkyl, heteroaryl, or an amino acid side chain;

wherein each each of R^{16} and R^{17} is, independently, hydrogen, (C_1 –C_6) alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, hydroxy, alkoxy, alkythio, aryl, aralkyl, or heteroaryl;

wherein D is a protecting group compatible with the conditions of phosphonoester or phosphonamide bond formation, R^{18}, or $NR^{18}R^{19}$;

wherein E is a protecting or activating group compatible with ester, phosphoester, or phosphonoester bond formation, O^-, R^{20}, $NR^{20}R^{21}$, or OR^{20}; and

wherein each R^{18}, R^{19}, R^{20}, and R^{21} is, independently, hydrogen, (C1-C6)alkyl, an amino protecting group, a reporter group, an intercalator, a chelator, a linker, a peptide, a protein, a carbohydrate, a lipid, a steroid, a nucleotide or oligonucleotide, or a soluble or nonsoluble polymer.

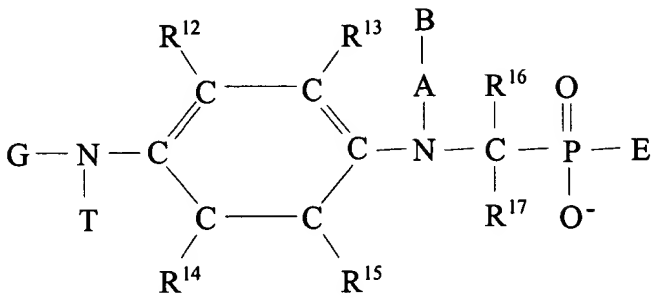
12. The compound of claim 1, wherein D is a protecting group selected from the group consisting of DMTr, MMTr, Tr, TBDMS, or tetraydropyranyl.

13. The compound of claim 2, wherein E is O^-, OH, 1-oxydo-4-methoxy-2-picolyloxy, phenoxy, 2-methylphenoxy, or 2-cyanoethoxy.

14. The compound of claim 1, wherein B is a nucleobase.

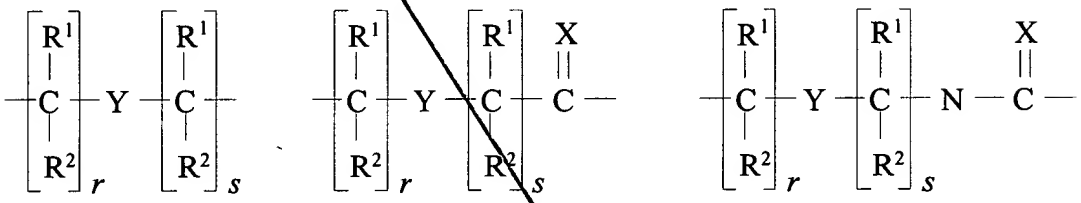
15. The compound of claim 3, wherein B is a naturally-occuring nucleobase.

16. A compound comprising the structure:



wherein B is H, a naturally occurring nucleobase, a non-naturally occurring nucleobase, an aromatic moiety, a DNA intercalator, a nucleobase-binding group, a heterocyclic moiety, or a reporter group, wherein amino groups are, optionally, protected by amino protecting groups;

wherein A is a group of formula (Ia), (Ib), or (Ic);



I(a) I(b) I(c)

wherein *r* and *s* are, for I(a) and I(b), independently of one another, values from 0 to 5 and are, for I(c), independently of one another, values from 1 to 5;

wherein each R^1 and each R^2 is, independently, hydrogen, (C_1 – C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 – C_6)alkyl, hydroxy, alkoxy, alkylthio, amino, or halogen;

wherein each of R^3, R^4, and R^5, is, independently, hydrogen,

$(C_1 - C_6)$alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted $(C_1 - C_6)$alkyl, hydroxy, alkoxy, amino, aryl, aralkyl, heteroaryl, or an amino acid side chain;

Y is a single bond, O, S, or NR^4; and

X is O, S, Se, NR^5, CH_2, or $C(CH_3)_2$;

wherein each of R^{12}, R^{13}, R^{14}, and R^{15}, is, independently, hydrogen, $(C_1 - C_6)$ alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted $(C_1 - C_6)$alkyl, hydroxy, alkoxy, alkylthio, amino, aryl, aralkyl, heteroaryl, or halogen;

wherein each of R^{16} and R^{17}, is, independently, hydrogen, $(C_1 - C_6)$alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted $(C_1 - C_6)$alkyl,aryl, aralkyl, or heteroaryl;

wherein E is a protecting or activating group compatible with the conditions of amide, phosphonoamide, or phosphonoester bond formation, O^-, R^{20}, $NR^{20}R^{21}$, or OR^{20};

wherein G is a protecting group compatible with the conditions of phosphonoester, phospho- or phosphonoamide bond formation, or R^{20};

wherein T is hydrogen, $(C_1 - C_6)$alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted $(C_1 - C_6)$alkyl, hydroxy, alkoxy, alkylthio, aryl, aralkyl, heteroaryl, or an amino acid side chain; and

wherein each R^{18}, R^{19}, R^{20}, and R^{21} is, independently, hydrogen, (C1-C6)alkyl, an amino protecting group, a reporter group, an intercalator, a chelator, a linker, a peptide, a protein, a carbohydrate, a lipid, a steroid, a nucleotide or oligonucleotide, or a soluble or nonsoluble polymer.

17. The compound of claim 2, wherein E is O^-, OH, 1-oxydo-4-methoxy-2-picolyloxy, phenoxy, 2-methylphenoxy, or 2-cyanoethoxy.

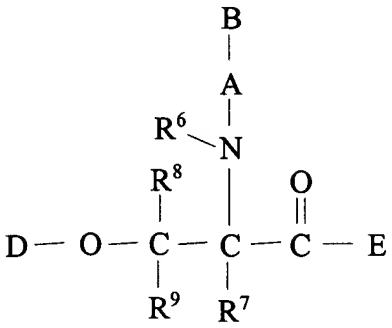
18. The compound of claim 16, wherein G is hydrogen, DMTr, MMTr, Tr, or Fmoc.

19. The compound of claim 16, wherein T is hydrogen.

20. The compound of claim 16, wherein B is a nucleobase.

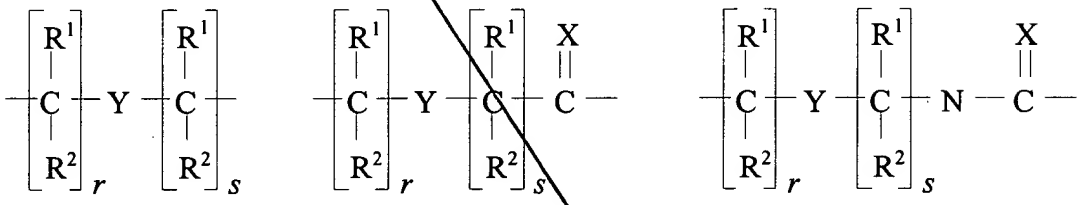
21. The compound of claim 20, wherein B is a naturally-occuring nucleobase.

22. A compound comprising the structure:



wherein B is H, a naturally occurring nucleobase, a non-naturally occurring nucleobase, an aromatic moiety, a DNA intercalator, a nucleobase-binding group, a heterocyclic moiety, or a reporter group, wherein amino groups are, optionally, protected by amino protecting groups;

wherein A is a group of formula (Ia), (Ib), or (Ic);



I(a) I(b) I(c)

wherein *r* and *s* are, for I(a) and I(b), independently of one another, values from 0 to 5 and are, for I(c), independently of one another, values from 1 to 5;

wherein each R^1 and each R^2 is, independently, hydrogen, (C_1 –C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, hydroxy, alkoxy, alkylthio, amino, or halogen;

wherein each R^3, R^4, and R^5, is, independently, hydrogen, (C_1 –C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, hydroxy, alkoxy, amino, aryl, aralkyl, heteroaryl, or an amino acid side chain;

Y is a single bond, O, S, or NR^4; and

X is O, S, Se, NR^5, CH_2, or $C(CH_3)_2$;

wherein R^6 is hydrogen, (C_1 –C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, hydroxy, alkoxy, alkylthio, amino, aryl, aralkyl, heteroaryl, or an amino acid side chain;

wherein each of R^7, R^8, and R^9 is, independently, hydrogen, (C_1 –C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, aryl, aralkyl, heteroaryl, or an amino acid side chain;

wherein D is a protecting group compatible with the conditions of ester, amide, or phosphonoester bond formation, R^{18}, or $NR^{18}R^{19}$;

wherein E is O^-, a protecting group compatible with ester, phosphoester, or phosphonoester bond formation, R^{20}, $NR^{20}R^{21}$, or OR^{20}; and

wherein each R^{18}, R^{19}, R^{20}, and R^{21} is, independently, hydrogen, (C1-C6)alkyl, an amino protecting group, a reporter group, an intercalator, a chelator, a linker, a peptide, a protein, a carbohydrate, a lipid, a steroid, a nucleotide or oligonucleotide, or a soluble or nonsoluble polymer.

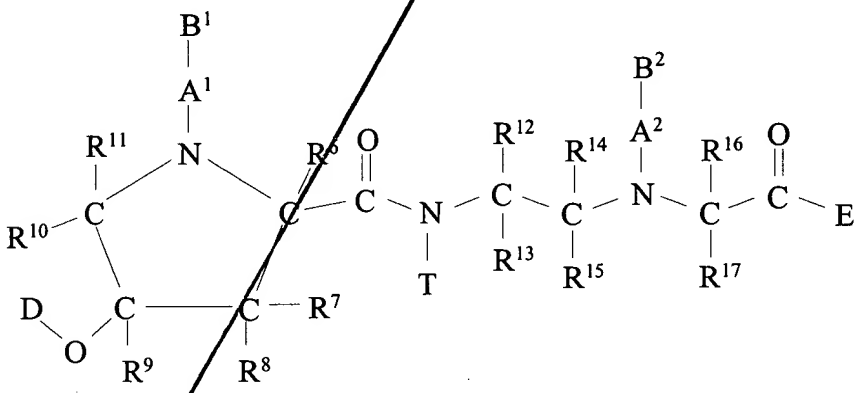
23. The compound of claim 22, wherein D is a protecting group selected from the group consisting of DMTr, MMTr, Tr, TBDMS, or tetraydropyranyl.

24. The compound of claim 22, wherein E is O^-, OH, or OCH_3.

25. The compound of claim 22, wherein B is a nucleobase.

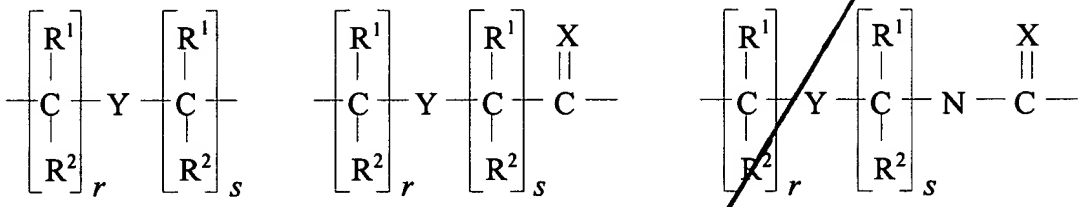
26. The compound of claim 23, wherein B is a naturally-occuring nucleobase.

27. A compound comprising the structure:



wherein each B^1 and each B^2 is, independently, H, a naturally occurring nucleobase, a non-naturally occurring nucleobase, an aromatic moiety, a DNA intercalator, a nucleobase-binding group, a heterocyclic moiety, or a reporter group, wherein amino groups are, optionally, protected by amino protecting groups;

wherein each of A^1 and A^2 is, independently, a group of formula (Ia), (Ib), or (Ic);



I(a) I(b) I(c)

wherein *r* and *s* are, for I(a) and I(b), independently of one another, values from 0 to 5 and are, for I(c), independently of one another, values from 1 to 5;

wherein each R^1 and each R^2 is, independently, hydrogen, (C_1 –C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, hydroxy, alkoxy, alkylthio, amino, or halogen;

wherein each R^3, R^4, and R^5, is, independently, hydrogen, (C_1 –C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, hydroxy, alkoxy, amino, aryl, aralkyl, heteroaryl, or an amino acid side chain;

Y is a single bond, O, S, or NR^4; and

X is O, S, Se, NR^5, CH_2, or $C(CH_3)_2$;

wherein R^6 is hydrogen, (C_1 –C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, aryl, aralkyl, heteroaryl, or an amino acid side chain;

wherein R^7 is, hydrogen, (C_1 –C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, hydroxy, alkoxy, alkylthio, amino, aryl, aralkyl, heteroaryl, or hydrogen, and R^8 is hydrogen, (C_1 –C_6) alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, aryl, aralkyl, or heteroaryl;

or R^7 is hydrogen, (C_1 –C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, aryl, aralkyl, or heteroaryl, and R^8 is hydrogen, (C_1 –C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, hydroxy, alkoxy, alkylthio, amino, aryl, aralkyl, heteroaryl, or halogen;

wherein R^9 is hydrogen, (C_1 –C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, alkoxy, aryl, arylkyl, or heteroaryl;

wherein each of R^{10} and R^{11} is, independently, hydrogen, (C_1 –C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, aryl, aralkyl, heteroaryl, or an amino acid side chain;

wherein each R^{12}, R^{13}, R^{14}, R^{15}, R^{16}, and R^{17} is, independently, hydrogen, (C_1 –C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, hydroxy, alkoxy, alkylthio, aryl, aralkyl, heteroaryl, or an amino acid side chain;

wherein D is a protecting group compatible with the conditions of ester, amide, or phosphonoester bond formation, R^{18}, or $NR^{18}R^{19}$;

wherein E is O^-, a protecting or activating group compatible with ester, phosphoester, or phosphonoester bond formation, R^{20}, $NR^{20}R^{21}$, or OR^{20};

wherein T is hydrogen, (C_1 –C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, hydroxy, alkoxy, alkylthio, aryl, aralkyl, heteroaryl, or an amino acid side chain; and

wherein each R^{18}, R^{19}, R^{20}, and R^{21} is, independently, hydrogen, (C1-C6)alkyl, an amino protecting group, a reporter group, an intercalator, a chelator, a linker, a peptide, a protein, a carbohydrate, a lipid, a steroid, a nucleotide or oligonucleotide, or a soluble or nonsoluble polymer.

28. The compound of claim 27, wherein D is a protecting group selected from the group consisting of DMTr, MMTr, Tr, TMDMS, or tetrahydropyranyl.

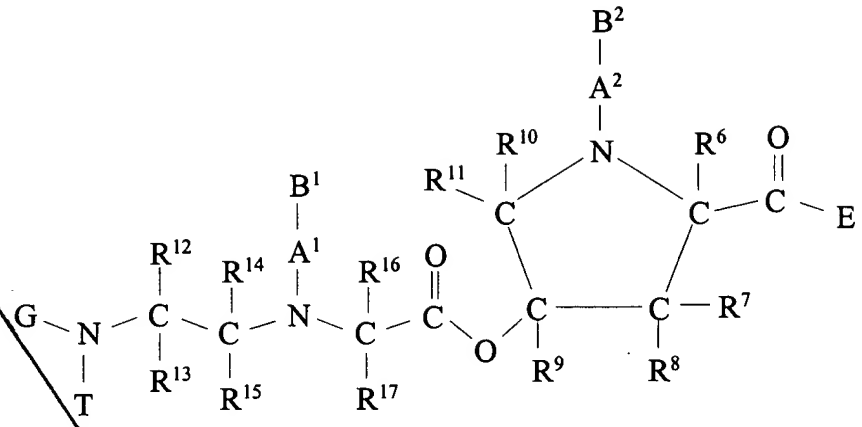
29. The compound of claim 27, wherein E is O^-, OH, or OCH_3.

30. The compound of claim 27, wherein T is hydrogen.

31. The compound of claim 27, wherein at least one of B^1 and B^2 is a nucleobase.

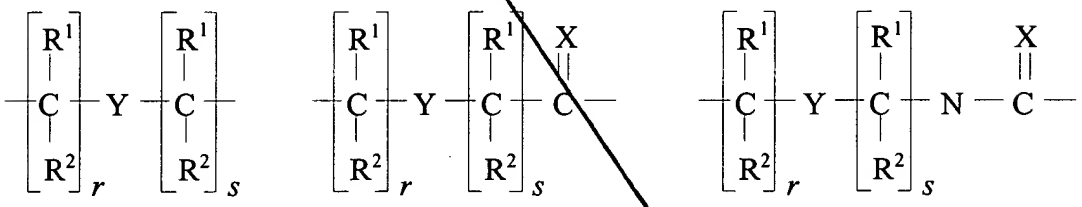
32. The compound of claim 31, wherein at least one of B^1 and B^2 is a naturally-occurring nucleobase.

33. A compound comprising the structure:



wherein each B^1 and each B^2 is, independently, H, a naturally occurring nucleobase, a non-naturally occurring nucleobase, an aromatic moiety, a DNA intercalator, a nucleobase-binding group, a heterocyclic moiety, or a reporter group, wherein amino groups are, optionally, protected by amino protecting groups;

wherein each of A^1 and A^2 is, independently, a group of formula (Ia), (Ib), or (Ic);



I(a) I(b) I(c)

wherein r and s are, for I(a) and I(b), independently of one another, values from 0 to 5 and are, for I(c), independently of one another, values from 1 to 5;

wherein each R^1 and each R^2 is, independently, hydrogen, $(C_1 – C_6)$alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted $(C_1 – C_6)$alkyl, hydroxy, alkoxy, alkylthio, amino, or halogen;

wherein each R^3, R^4, and R^5, is, independently, hydrogen, $(C_1 – C_6)$alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted $(C_1 – C_6)$alkyl, hydroxy, alkoxy, amino, aryl, aralkyl, heteroaryl, or an amino acid side chain;

Y is a single bond, O, S, or NR^4; and

X is O, S, Se, NR^5, CH_2, or $C(CH_3)_2$;

wherein R^6 is hydrogen, $(C_1 – C_6)$alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted $(C_1 – C_6)$alkyl, aryl, aralkyl, heteroaryl, or an amino acid side chain;

wherein R^7 is, hydrogen, $(C_1 – C_6)$alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted $(C_1 – C_6)$alkyl, hydroxy, alkoxy, alkylthio, amino, aryl, aralkyl, heteroaryl, or hydrogen, and R^8 is hydrogen, $(C_1 – C_6)$ alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted $(C_1 – C_6)$alkyl, aryl, aralkyl, or heteroaryl;
or R^7 is hydrogen, $(C_1 – C_6)$alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted $(C_1 – C_6)$alkyl, aryl, aralkyl, or heteroaryl, and R^8 is hydrogen, $(C_1 – C_6)$alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted $(C_1 – C_6)$alkyl, hydroxy, alkoxy, alkylthio, amino, aryl, aralkyl, heteroaryl, or halogen;

wherein R^9 is hydrogen, $(C_1 – C_6)$alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted $(C_1 – C_6)$alkyl, alkoxy, aryl, arylkyl, or heteroaryl;

wherein each of R^{10} and R^{11} is, independently, hydrogen, $(C_1 - C_6)$alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted $(C_1 - C_6)$alkyl, aryl, aralkyl, heteroaryl, or an amino acid side chain;

wherein each R^{12}, R^{13}, R^{14}, R^{15}, R^{16}, and R^{17} is, independently, hydrogen, $(C_1 - C_6)$alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted $(C_1 - C_6)$alkyl, hydroxy, alkoxy, alkylthio, aryl, aralkyl, heteroaryl, or an amino acid side chain;

wherein G is a protecting group compatible with the conditions of ester, amide, or phosphonoester bond formation, R^{18}, or $NR^{18}R^{19}$;

wherein E is O^-, a protecting or activating group compatible with ester, phosphoester, or phosphonoester bond formation, R^{20}, $NR^{20}R^{21}$, or OR^{20};

wherein T is hydrogen, $(C_1 - C_6)$alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted $(C_1 - C_6)$alkyl, hydroxy, alkoxy, alkylthio, aryl, aralkyl, heteroaryl, or an amino acid side chain; and

wherein each R^{18}, R^{19}, R^{20}, and R^{21} is, independently, hydrogen, (C1-C6)alkyl, an amino protecting group, a reporter group, an intercalator, a chelator, a linker, a peptide, a protein, a carbohydrate, a lipid, a steroid, a nucleotide or oligonucleotide, or a soluble or nonsoluble polymer.

34. The compound of claim 33, wherein G is a protecting group selected from the group consisting of DMTr, MMTr, Tr, TMDMS, or tetrahydropyranyl.

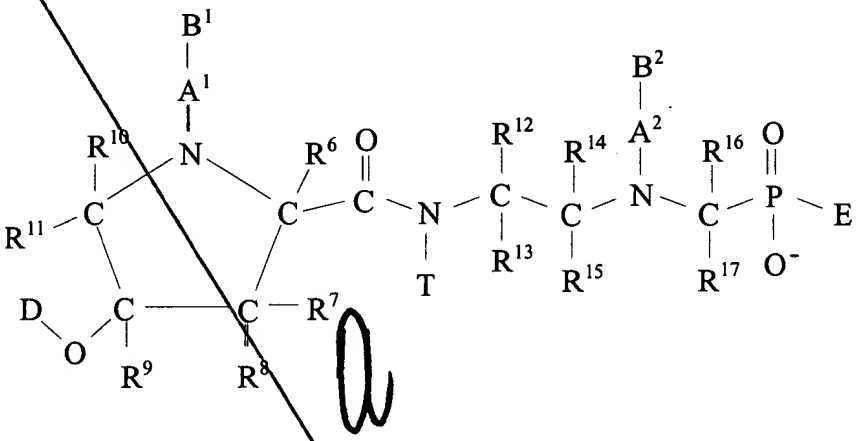
35. The compound of claim 33, wherein E is O^-, OH, or OCH_3.

36. The compound of claim 33, wherein T is hydrogen.

37. The compound of claim 33, wherein at least one of B^1 and B^2 is a nucleobase.

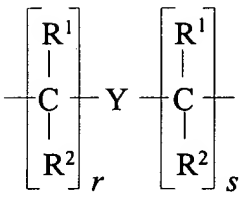
38. The compound of claim 37, wherein at least one of B^1 and B^2 is a naturally-occurring nucleobase.

39. A compound comprising the structure:

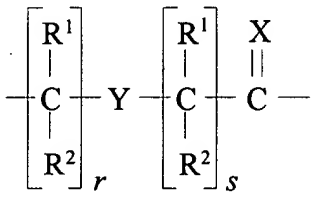


wherein each of B^1 and B^2 is, independently, H, a naturally occurring nucleobase, a non-naturally occurring nucleobase, an aromatic moiety, a DNA intercalator, a nucleobase-binding group, a heterocyclic moiety, or a reporter group, wherein amino groups are, optionally, protected by amino protecting groups;

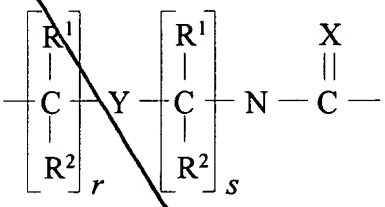
wherein each of A^1 and A^2 is, independently, a group of formula (Ia), (Ib), or (Ic);



I(a)



I(b)



I(c)

wherein *r* and *s* are, for I(a) and I(b), independently of one another, values from 0 to 5 and are, for I(c), independently of one another, values from 1 to 5;

wherein each R^1 and each R^2 is, independently, hydrogen, (C_1 –C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, hydroxy, alkoxy, alkylthio, amino, or halogen;
wherein each R^3, R^4, and R^5, is, independently, hydrogen, (C_1 –C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, hydroxy, alkoxy, amino, aryl, aralkyl, heteroaryl, or an amino acid side chain;

Y is a single bond, O, S, or NR^4; and

X is O, S, Se, NR^5, CH_2, or $C(CH_3)_2$;

wherein R^6 is hydrogen, (C_1 –C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, aryl, aralkyl, heteroaryl, or an amino acid side chain;

wherein R^7 is, hydrogen, (C_1 –C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, hydroxy, alkoxy, alkylthio, amino, aryl, aralkyl, heteroaryl, or hydrogen, and R^8 is hydrogen, (C_1 –C_6) alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, aryl, aralkyl, or heteroaryl;
or R^7 is hydrogen, (C_1 –C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, aryl, aralkyl, or heteroaryl, and R^8 is hydrogen, (C_1 –C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, hydroxy, alkoxy, alkylthio, amino, aryl, aralkyl, heteroaryl, or halogen;

wherein R^9 is hydrogen, (C_1 –C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, alkoxy, aryl, arylkyl, or heteroaryl;

wherein each of R^{10} and R^{11} is, independently, hydrogen, (C_1 –C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, aryl, aralkyl, heteroaryl, or an amino acid side chain;

wherein each of R^{12}, R^{13}, R^{14}, R^{15}, R^{16}, and R^{17} is, independently, hydrogen, (C_1 –C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, hydroxy, alkoxy, alkylthio, aryl, aralkyl, heteroaryl, or an amino acid side chain;

wherein D is a protecting group compatible with the conditions of ester, amide, or phosphonoester bond formation, R^{18}, or $NR^{18}R^{19}$;

wherein E is O^-, a protecting or activating group compatible with ester, phosphoester, or phosphonoester bond formation, R^{20}, $NR^{20}R^{21}$, or OR^{20};

wherein T is hydrogen, (C_1 –C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, hydroxy, alkoxy, alkylthio, aryl, aralkyl, heteroaryl, or an amino acid side chain; and

wherein each R^{18}, R^{19}, R^{20}, and R^{21} is, independently, hydrogen, (C1-C6)alkyl, an amino protecting group, a reporter group, an intercalator, a chelator, a linker, a peptide, a protein, a carbohydrate, a lipid, a steroid, a nucleotide or oligonucleotide, or a soluble or nonsoluble polymer.

40. The compound of claim 39, wherein D is a protecting group selected from the group consisting of DMTr, MMTr, Tr, TMDMS, or tetrahydropyranyl.

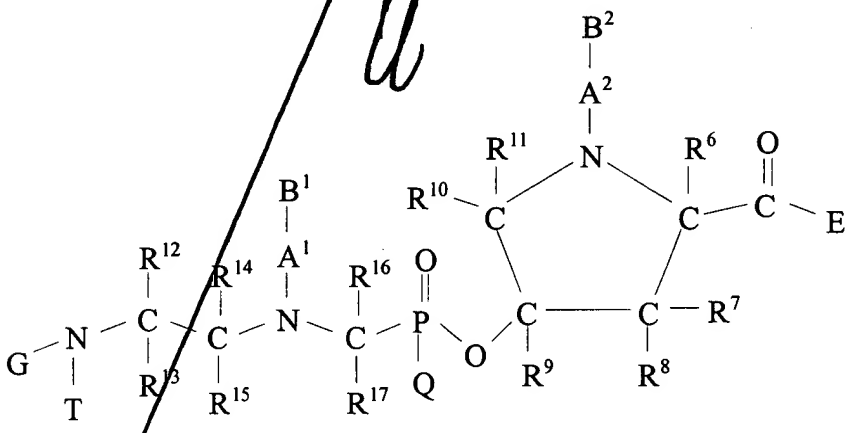
41. The compound of claim 39, wherein E is O^-, OH, 1-oxydo-4-methoxy-2-picolyloxy, phenoxy, 2-methylphenoxy, or 2-cyanoethoxy

42. The compound of claim 39, wherein T is hydrogen.

43. The compound of claim 39, wherein at least one of B^1 and B^2 is a nucleobase.

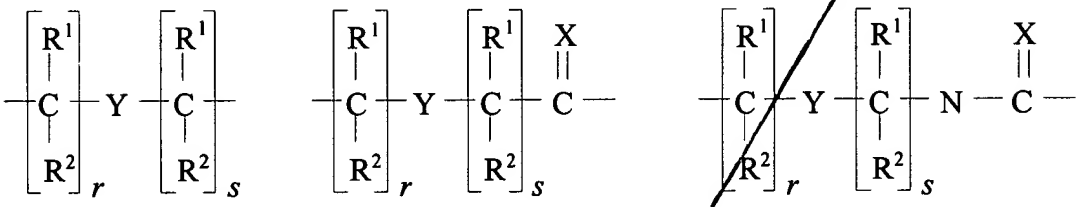
44. The compound of claim 43, wherein at least one of B^1 and B^2 is a naturally-occurring nucleobase.

45. A compound comprising the structure:



wherein each B^1 and each B^2 is, independently, H, a naturally occurring nucleobase, a non-naturally occurring nucleobase, an aromatic moiety, a DNA intercalator, a nucleobase-binding group, a heterocyclic moiety, or a reporter group, wherein amino groups are, optionally, protected by amino protecting groups;

wherein each of A^1 and A^2 is, independently, a group of formula (Ia), (Ib), or (Ic);



I(a) I(b) I(c)

wherein r and s are, for I(a) and I(b), independently of one another, values from 0 to 5 and are, for I(c), independently of one another, values from 1 to 5;

wherein each R^1 and each R^2 is, independently, hydrogen, $(C_1 – C_6)$alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted $(C_1 – C_6)$alkyl, hydroxy, alkoxy, alkylthio, amino, or halogen;

wherein each R^3, R^4, and R^5, is, independently, hydrogen, $(C_1 – C_6)$alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted $(C_1 – C_6)$alkyl, hydroxy, alkoxy, amino, aryl, aralkyl, heteroaryl, or an amino acid side chain;

Y is a single bond, O, S, or NR^4; and

X is O, S, Se, NR^5, CH_2, or $C(CH_3)_2$;

wherein R^6 is hydrogen, $(C_1 – C_6)$alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted $(C_1 – C_6)$alkyl, aryl, aralkyl, heteroaryl, or an amino acid side chain;

wherein R^7 is, hydrogen, (C_1 –C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, hydroxy, alkoxy, alkylthio, amino, aryl, aralkyl, heteroaryl, or hydrogen, and R^8 is hydrogen, (C_1 –C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, aryl, aralkyl, or heteroaryl;

or R^7 is hydrogen, (C_1 –C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, aryl, aralkyl, or heteroaryl, and R^8 is hydrogen, (C_1 –C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, hydroxy, alkoxy, alkylthio, amino, aryl, aralkyl, heteroaryl, or halogen;

wherein R^9 is hydrogen, (C_1 –C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, alkoxy, aryl, arylkyl, or heteroaryl;

wherein each of R^{10} and R^{11} is, independently, hydrogen, (C_1 –C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, aryl, aralkyl, heteroaryl, or an amino acid side chain;

wherein each R^{12}, R^{13}, R^{14}, R^{15}, R^{16}, and R^{17} is, independently, hydrogen, (C_1 –C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, hydroxy, alkoxy, alkylthio, aryl, aralkyl, heteroaryl, or an amino acid side chain;

wherein G is hydrogen, a protecting group compatible with the conditions of ester, amide, or phosphonoester bond formation or R^{20};

wherein E is O^-, a protecting or activating group compatible with amide or phosphonamide bond formation, R^{20}, $NR^{20}R^{21}$, or OR^{20};

wherein Q is O^-, a protecting or activating group compatible with the conditions of amide, ester, phosphonoester, and phosphonamide bond formation or OR^{20}; and

wherein each R^{18}, R^{19}, R^{20}, and R^{21} is, independently, hydrogen, (C1-C6)alkyl, an amino protecting group, a reporter group, an intercalator, a chelator, a linker, a peptide, a protein, a carbohydrate, a lipid, a steroid, a nucleotide or oligonucleotide, or a soluble or nonsoluble polymer.

46. The compound of claim 45, wherein G is a protecting group selected from the group consisting of DMTr, MMTr, Tr, TMDMS, or tetrahydropyranyl.

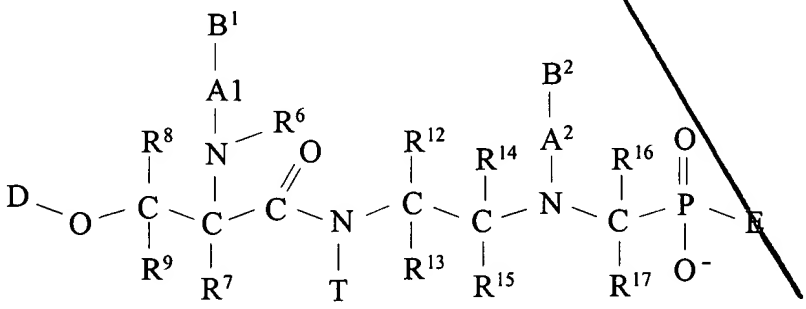
47. The nucleotide analogue of claim 45, wherein E is O^-, OH, or or OCH_3.

48. The compound of claim 45, wherein Q is O^-, OH, 1-oxydo-4-methoxy-2-picolyloxy, phenoxy, 2-methylphenoxy, or 2-cyanoethoxy.

49. The compound of claim 45, wherein at least one of B^1 and B^2 is a nucleobase.

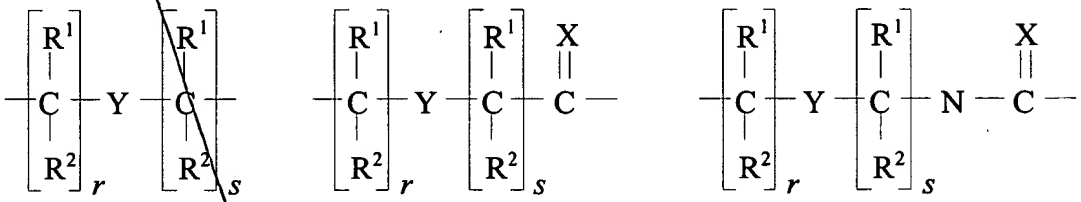
50. The compound of claim 49, wherein at least one of B^1 and B^2 is a naturally-occurring nucleobase.

51. A compound comprising the structure:



wherein each B^1 and each B^2 is, independently, H, a naturally occurring nucleobase, a non-naturally occurring nucleobase, an aromatic moiety, a DNA intercalator, a nucleobase-binding group, a heterocyclic moiety, or a reporter group, wherein amino groups are, optionally, protected by amino protecting groups;

wherein each of A^1 and A^2 is, independently, a group of formula (Ia), (Ib), or (Ic);



I(a) I(b) I(c)

wherein r and s are, for I(a) and I(b), independently of one another, values from 0 to 5 and are, for I(c), independently of one another, values from 1 to 5;

wherein each R^1 and each R^2 is, independently, hydrogen, (C_1 –C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, hydroxy, alkoxy, alkylthio, amino, or halogen;

wherein each R^3, R^4, and R^5, is, independently, hydrogen, (C_1 –C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, hydroxy, alkoxy, amino, aryl, aralkyl, heteroaryl, or an amino acid side chain;

Y is a single bond, O, S, or NR^4; and

X is O, S, Se, NR^5, CH_2, or $C(CH_3)_2$;

wherein R^6 is hydrogen, (C_1 –C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, hydroxy, alkoxy, alkylthio, amino, aryl, aralkyl, heteroaryl, or an amino acid side chain;

wherein each of R^7, R^8, and R^9 is, independently, hydrogen, (C_1 –C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, aryl, aralkyl, heteroaryl, or an amino acid side chain;

wherein each of R^{12}, R^{13}, R^{14}, R^{15}, R^{16}, and R^{17} is, independently, hydrogen, (C_1 –C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, hydroxy, alkoxy, alkylthio, aryl, aralkyl, heteroaryl, or an amino acid side chain;

wherein D is a protecting group compatible with the conditions of phophoester, phosphonamide, or phosphonoester bond formation, R^{18}, or $NR^{18}R^{19}$;

wherein E is O^-, a protecting or activating group compatible with ester, phosphoester, or phosphonoester bond formation, R^{20}, $NR^{20}R^{21}$, or OR^{20};

wherein T is hydrogen, (C_1 –C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, hydroxy, alkoxy, alkylthio, aryl, aralkyl, heteroaryl, or an amino acid side chain; and

wherein each R^{18}, R^{19}, R^{20}, and R^{21} is, independently, hydrogen, alkyl, an amino protecting group, a reporter group, an intercalator, a chelator, a linker, a peptide, a protein, a carbohydrate, a lipid, a steroid, a nucleotide or olgonucleotide, or a soluble or nonsoluble polymer.

52. The compound of claim 51, wherein D is a protecting group selected from the group consisting of DMTr, MMTr, Tr, TMDMS, or tetrahydropyranyl.

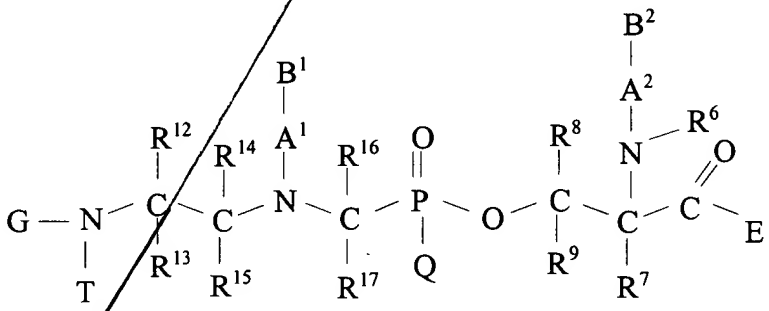
53. The compound of claim 51, wherein E is O^-, OH, 1-oxydo-4-methoxy-2-picolyloxy, phenoxy, 2-methylphenoxy, or 2-cyanoethoxy.

54. The compound of claim 51, wherein T is hydrogen.

55. The compound of claim 57, wherein at least one of B^1 and B^2 is a nucleobase.

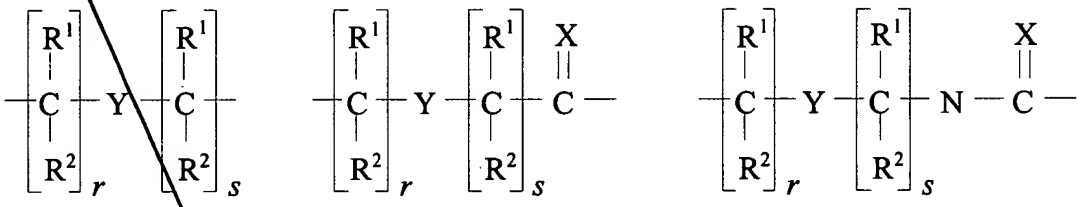
56. The compound of claim 61, wherein at least one of B^1 and B^2 is a naturally-occurring nucleobase.

57. A compound comprising the structure:



wherein each B^1 and each B^2 is, independently, H, a naturally occurring nucleobase, a non-naturally occurring nucleobase, an aromatic moiety, a DNA intercalator, a nucleobase-binding group, a heterocyclic moiety, or a reporter group, wherein amino groups are, optionally, protected by amino protecting groups;

wherein each of A^1 and A^2 is, independently, a group of formula (Ia), (Ib), or (Ic);



I(a) I(b) I(c)

wherein r and s are, for I(a) and I(b), independently of one another, values from 0 to 5 and are, for I(c), independently of one another, values from 1 to 5;

wherein each R^1 and each R^2 is, independently, hydrogen, (C_1 –C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, hydroxy, alkoxy, alkylthio, amino, or halogen;

wherein each R^3, R^4, and R^5, is, independently, hydrogen, (C_1 –C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, hydroxy, alkoxy, amino, aryl, aralkyl, heteroaryl, or an amino acid side chain;

Y is a single bond, O, S, or NR^4; and

X is O, S, Se, NR^5, CH_2, or $C(CH_3)_2$;

wherein R^6 is hydrogen, (C_1 –C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, hydroxy, alkoxy, alkylthio, amino, aryl, aralkyl, heteroaryl, or an amino acid side chain;

wherein each of R^7, R^8, and R^9 is, independently, hydrogen,

$(C_1 - C_6)$alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted $(C_1 - C_6)$alkyl, aryl, aralkyl, heteroaryl, or an amino acid side chain;

wherein each of R^{12}, R^{13}, R^{14}, R^{15}, R^{16}, and R^{17} is, independently, hydrogen, $(C_1 - C_6)$alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted $(C_1 - C_6)$alkyl, hydroxy, alkoxy, alkylthio, aryl, aralkyl, heteroaryl, or an amino acid side chain;

wherein G is hydrogen, a protecting group compatible with the conditions of ester, amide, or phosphonoester bond formation or R^{20};

wherein E is O^-, a protecting or activating group compatible with amide or phosphonamide bond formation, R^{20}, $NR^{20}R^{21}$, or OR^{20};

wherein Q is O^-, a protecting or activating group compatible with the conditions of amide, ester, phosphonoester, and phosphonamide bond formation or OR^{20};

wherein T is hydrogen, $(C_1 - C_6)$alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted $(C_1 - C_6)$alkyl, hydroxy, alkoxy, alkylthio, aryl, aralkyl, heteroaryl, or an amino acid side chain; and

wherein each R^{18}, R^{19}, R^{20}, and R^{21} is, independently, hydrogen, alkyl, an amino protecting group, a reporter group, an intercalator, a chelator, a linker, a peptide, a protein, a carbohydrate, a lipid, a steroid, a nucleotide or olgonucleotide, or a soluble or nonsoluble polymer.

58. The compound of claim 57, wherein G is a protecting group selected from the group consisting of DMTr, MMTr, Tr, TMDMS, or tetrahydropyranyl.

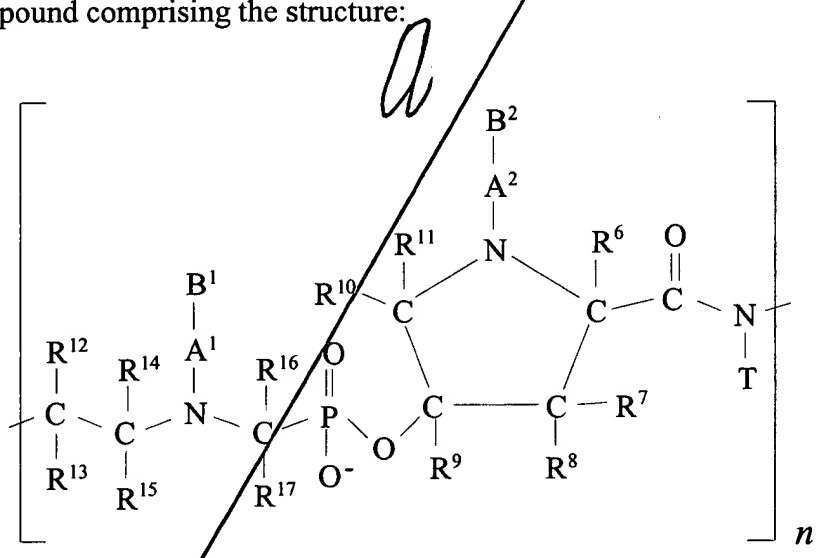
59. The compound of claim 57, wherein E is O^-, OH, or or OCH_3.

60. The compound of claim 57, wherein Q is O^-, OH, 1-oxydo-4-methoxy-2-picolyloxy, phenoxy, 2-methylphenoxy, or 2-cyanoethoxy.

61. The compound of claim 57, wherein at least one of B^1 and B^2 is a nucleobase.

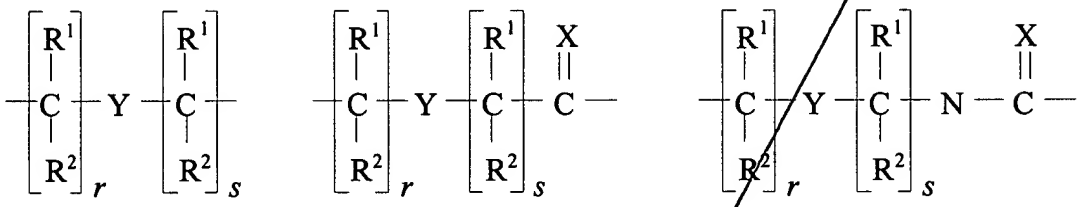
62. The compound of claim 61, wherein at least one of B^1 and B^2 is a naturally-occurring nucleobase.

63. A compound comprising the structure:



wherein each B^1 and each B^2 is, independently, H, a naturally occurring nucleobase, a non-naturally occurring nucleobase, an aromatic moiety, a DNA intercalator, a nucleobase-binding group, a heterocyclic moiety, or a reporter group, wherein amino groups are, optionally, protected by amino protecting groups;

wherein each A^1 and each A^2 is, independently, is a group of formula (Ia), (Ib), or (Ic);



I(a) I(b) I(c)

wherein *r* and *s* are, for I(a) and I(b), independently of one another, values from 0 to 5 and are, for I(c), independently of one another, values from 1 to 5;

wherein each R^1 and each R^2 is, independently, hydrogen, (C_1 –C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, hydroxy, alkoxy, alkylthio, amino, or halogen;

wherein each R^3, R^4, and R^5, is, independently, hydrogen, (C_1 –C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, hydroxy, alkoxy, amino, aryl, aralkyl, heteroaryl, or an amino acid side chain;

Y is a single bond, O, S, or NR^4; and

X is O, S, Se, NR^5, CH_2, or $C(CH_3)_2$;

wherein each R^6 is, independently, hydrogen, (C_1 –C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, aryl, aralkyl, heteroaryl, or an amino acid side chain;

wherein R^7 is, independently, hydrogen, (C_1 –C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, hydroxy, alkoxy, alkylthio, amino, aryl, aralkyl, heteroaryl, or hydrogen, and R^8 is hydrogen, (C_1 –C_6) alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, aryl, aralkyl, or heteroaryl;

or R^7 is hydrogen, (C_1 –C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, aryl, aralkyl, or heteroaryl, and R^8 is hydrogen, (C_1 –C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, hydroxy, alkoxy, alkylthio, amino, aryl, aralkyl, heteroaryl, or halogen;

wherein each R^9 is independently, hydrogen, (C_1 –C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, alkoxy, aryl, arylkyl, or heteroaryl;

wherein each R^{10} and each R^{11} is, independently, hydrogen, (C_1 –C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, aryl, aralkyl, heteroaryl, or an amino acid side chain;

wherein each R^{12}, R^{13}, R^{14}, R^{15}, R^{16}, and each R^{17} is, independently, hydrogen, (C_1 –C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, hydroxy, alkoxy, alkylthio, aryl, aralkyl, heteroaryl, or an amino acid side chain;

wherein T is hydrogen, (C_1 –C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1 –C_6)alkyl, hydroxy, alkoxy, alkylthio, aryl, aralkyl, heteroaryl, or an amino acid side chain;

wherein each R^{18}, R^{19}, R^{20}, and R^{21} is, independently, hydrogen, (C1-C6)alkyl, an amino protecting group, a reporter group, an intercalator, a chelator, a linker, a peptide, a protein, a carbohydrate, a lipid, a steroid, a nucleotide or oligonucleotide, or a soluble or nonsoluble polymer; and

n is 1 or greater.

64. The compound of claim 63, further comprising one or more oligonucleotide analogue monomers.

65. The compound of claim 64, wherein at least one of said one or more additional oligonucleotide analogue monomers comprises the compound of claim 1 or a phosphono peptide nucleic acid monomer.

66. The compound of claim 65, wherein the ratio of claim 1 monomers to phosphono peptide nucleic acid monomers is between about 1: 15 to about 5: 3.

67. The compound of claim 63, wherein at least one B^1 or at least one B^2 is a nucleobase.

68. The compound of claim 67, wherein at least one B^1 or at least one B^2 is a naturally-occurring nucleobase.

69. The compound of claim 63 hybridized to a nucleic acid molecule.

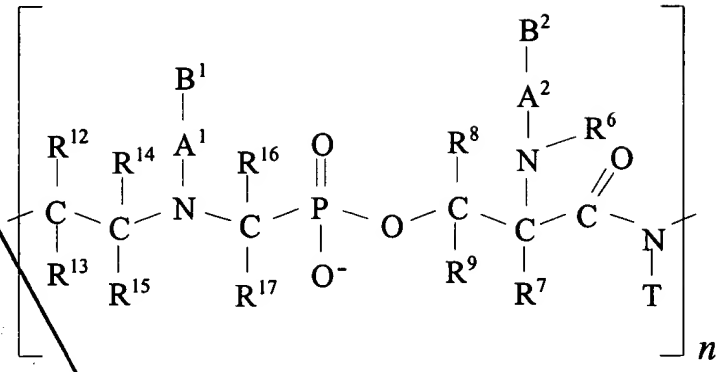
70. The compound of claim 64 hybridized to a nucleic acid molecule.

71. The compound of claim 63 bound to a solid support.

72. The compound of claim 71, wherein said solid support comprises a polymer.

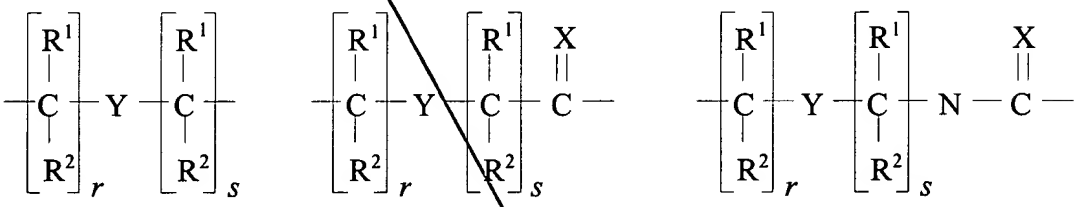
73. The compound of claim 64 bound to a solid support.

74. A compound comprising the structure:



wherein each B^1 and each B^2 is, independently, H, a naturally occurring nucleobase, a non-naturally occurring nucleobase, an aromatic moiety, a DNA intercalator, a nucleobase-binding group, a heterocyclic moiety, or a reporter group, wherein amino groups are, optionally, protected by amino protecting groups;

wherein each of A^1 and each A^2 is, independently, a group of formula (Ia), (Ib), or (Ic);



I(a) I(b) I(c)

wherein r and s are, for I(a) and I(b), independently of one another, values from 0 to 5 and are, for I(c), independently of one another, values from 1 to 5;

wherein each R^1 and each R^2 is, independently, hydrogen, (C_1-C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1-C_6)alkyl, hydroxy, alkoxy, alkylthio, amino, or halogen;

wherein each R^3, R^4, and R^5, is, independently, hydrogen, (C_1-C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1-C_6)alkyl, hydroxy, alkoxy, amino, aryl, aralkyl, heteroaryl, or an amino acid side chain;

Y is a single bond, O, S, or NR^4; and

X is O, S, Se, NR^5, CH_2, or $C(CH_3)_2$;

wherein each R^6 is hydrogen, (C_1-C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1-C_6)alkyl, hydroxy, alkoxy, alkylthio, amino, aryl, aralkyl, heteroaryl, or an amino acid side chain;

wherein each R^7, R^8, and R^9 is, independently, hydrogen, (C_1-C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1-C_6)alkyl, aryl, aralkyl, heteroaryl, or an amino acid side chain;

wherein each R^{12}, R^{13}, R^{14}, R^{15}, R^{16}, and R^{17} is, independently, hydrogen, (C_1-C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1-C_6)alkyl, hydroxy, alkoxy, alkylthio, aryl, aralkyl, heteroaryl, or an amino acid side chain;

wherein T is hydrogen, (C_1-C_6)alkyl, hydroxy-, alkoxy-, amino-, or alkythio-substituted (C_1-C_6)alkyl, hydroxy, alkoxy, alkylthio, aryl, aralkyl, heteroaryl, or an amino acid side chain;

wherein each R^{18}, R^{19}, R^{20}, and R^{21} is, independently, hydrogen, alkyl, an amino protecting group, a reporter group, an intercalator, a chelator, a linker, a peptide, a protein, a carbohydrate, a lipid, a steroid, a nucleotide or oligonucleotide, or a soluble or nonsoluble polymer; and

n is one or greater.

75. The compound of claim 74, further comprising one or more oligonucleotide analogue monomers.

76. The compound of claim 75, wherein at least one of said one or more additional oligonucleotide analogue monomers comprises the compound of claim 6 or a phosponate peptide nucleic acid monomer.

77. The compound of claim 76, wherein the ratio of claim 6 monomers to phosphono peptide nucleic acid monomers is between about 1: 15 to about 5: 3.

78. The compound of claim 74, wherein at least one B^1 or at least one B^2 is a nucleobase.

79. The compound of claim 78, wherein at least one B^1 or at least one B^2 is a naturally-occurring nucleobase.

80. The compound of claim 74 hybridized to a nucleic acid molecule.

81. The compound of claim 75 hybridized to a nucleic acid molecule.

82. The compound of claim 74 bound to a solid support.

83. The compound of claim 75 bound to a solid support.

84. A method of synthesizing the oligonucleotide analogue compound of claim 63, comprising:

(a) coupling a compound of claim 39 to a solid support to form support-coupled compound;

(b) deprotecting the terminal hydroxyl group of the support-coupled compound; and

(c) coupling a compound of claim 39 to the support-coupled compound by forming a phosphonodiester bond to form the oligonucleotide analogue compound of claim 63;

85. The method of claim 84, wherein said coupling is catalyzed by 1-(2,4,6-triisopropylbenzene-sulfonyl)-3-nitro-1,2,4-triazole.

86. A method for synthesizing the oligonucleotide analogue compound of claim 74 , comprising:

(a) coupling the compound of claim 51 to a solid support to form a support-coupled compound;

(b) deprotecting the terminal hydroxyl group of the support-coupled compound; and

(c) coupling a dimer of claim 51 to the support-coupled compound by forming a phosphonate diester bond to synthesize the compound of claim 74.

87. The method of claim 86, wherein said coupling is catalyzed by 1-(2,4,6triisopropylbenzene-sulfonyl)-3-nitro-1,2,4-triazole.

88. The compound of claim 39, further comprising a covalently linked ethylene-containing monomer unit capable of polymerizing with at least one other ethylene containing monomer unit.

89. The compound of claim 88, wherein said ethylene-containing monomer unit is an acrylamide monomer unit.

90. The compound of claim 89, wherein said covalently linked ethylene-containing monomer unit is linked to said compound of claim 39 via a linker.

91. The compound of claim 51, further comprising a covalently linked ethylene-containing monomer unit capable of polymerizing with at least one other ethylene containing monomer unit.

92. The compound of claim 91, wherein said ethylene-containing monomer unit is an acrylamide monomer unit.

93. The compound of claim 92, wherein said covalently linked ethylene-containing monomer unit is linked to said compound of claim 51 via a linker.

94. A method for detecting a nucleic acid molecule, comprising:

providing a sample;

contacting the oligonucleotide analogue of claim 39 with said sample under conditions that allow hybridization of nucleic acid molecules with oligonucleotide analogues; and

detecting at least one nucleic acid molecule that is hybridized to said oligonucleotide analogue.

95. A method for separating, isolating, or purifying at least one nucleic acid molecule from a population of nucleic acid molecules, comprising:

providing a population of nucleic acid molecules;

contacting the population of nucleic acid molecules with one or more capture probes comprising at least one oligonucleotide analogue of claim 39 under conditions that allow hybridization of nucleic acid molecules with oligonucleotide analogues; and

separating at least one nucleic acid molecule that is hybridized to said one or more capture probes from the members of the population of nucleic acid molecules that are not hybridized to said one or more capture probes.

96. A method for enhancing or inhibiting the activity of an enzyme or cellular activity, comprising:

providing a subject, sample, or solution comprising an enzyme or cellular activity;

adding at least one oligonucleotide analogue of claim 39 to said subject, sample, or solution; and

providing conditions under which the enzyme or cellular activity has at least one activity in the presence or absence of said oligonucleotide analogue.